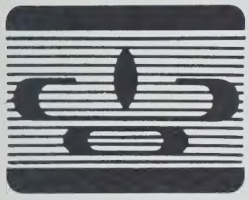
ontario educational television

grades 1-6 mathematics everywhere

1966-67
September-December Series

Mathematics Everywhere

A SERIES OF ELEVEN PROGRAMS DESIGNED
FOR JUNIOR DIVISION MATHEMATICS



Ontario Educational Television
Ontario Department of Education

Prepared and written by
K. W. KENNEY, Staff Inspector (Mathematics)
Midwestern Area, Waterloo.
and
L. HOOPER, Staff Inspector (Mathematics)
Northeastern Area, North Bay.

Subject Supervisor
J. K. CROSSLEY, Assistant Superintendent,
Curriculum Division,
Department of Education.

Suggestions for Viewing Television in the Classroom

THE TELEVISION SET

1 Switch on the television set at least five minutes before the start of the program. Turn the volume control down and cover the picture by adjusting the doors of the set, or cover with drapery or other material. This will ensure a minimum of class interruption during the warm-up procedure.

2 Two minutes prior to telecast, make the necessary adjustments to the brightness and contrast controls to ensure picture clarity. Keep volume turned down.

3 Approximately twenty seconds prior to telecast time remove the screen cover and adjust the volume control. Try to avoid adjustments during the program telecast.

4 Window and other lighting reflections on the screen may occur if the television set is positioned at certain angles to light sources. This condition can be avoided by re-positioning the television set or through the use of the cabinet doors. If there are no doors, cardboard shields may be easily fashioned and fixed to the set.

ENVIRONMENTAL FACTORS

5 It is not necessary to black out the classroom. If lighting can be slightly dimmed by closing window drapery or switching off some lights, acceptable light level should result.

6 Tests should be made prior to the broadcast, to ensure that the maximum benefits of viewing and listening are available to each pupil. The seating arrangements will obviously vary with room shapes, type of furniture and number of pupils, but no pupil should be placed in a position that is greater than a 45° angle from a line drawn straight from the centre of the picture tube. Using a 23-inch screen, the minimum distance between pupil and picture should be approximately five feet, and maximum distance from picture should be approximately twenty feet. The television receiver should be raised to a height so that the centre of the picture tube is approximately 66 inches above floor level.

7 These approximate measurements indicate that a square or wide classroom shape is much better than a long narrow room unless, of course, desks can be turned towards a long wall or aligned towards a corner.

CAUTION: The measurements shown above are approximate. They may not apply to all classrooms and are offered as a guide only. Long extension cords, antenna leads, and insecure structures for the elevation of the television set should be avoided. Pupils should be discouraged from assisting in setting up the television set or making any adjustments to it.

Mathematics Everywhere

INTRODUCTION

The guide materials in this booklet have been written to assist teachers in the preparation for and utilization of the series of in-school programs entitled, *Mathematics Everywhere*. It is anticipated that the 11 half-hour programs in this series will be of greatest value to classes in the Junior Division of the elementary schools. However, if facilities are available, older children in the Primary Division should be given the opportunity to benefit from the programs as well.

The prime objectives of the series are:

1 To help teachers assist children gain deeper insights into mathematical ideas.

2 To help children develop an appreciation of mathematics.

3 To help children realize that the study of mathematics can be a joy.

The setting for each program is a teacher's desk with a magnetic chalk board in the background. Behind this desk is a busy little worker named "Double M". Double M is a puppet who performs experiments, displays visual materials, discusses important ideas with the narrator, and occasionally entertains the pupil audience.

With Double M's ability to demonstrate, the main ideas are told by the narrator who is never seen on the set. The children *hear* the explanations of the narrator. At the same time they *see* graphic demonstrations in action, which makes the explanations live. In several programs the children *do* exercises while the program is in progress. It is anticipated that the combination of *hearing, seeing,* and *doing* will provide for greater understanding of the mathematical ideas discussed.

The aims stated on page 2 of Interim Revision Mathematics Curriculum (P1, J1) 1966 could easily serve as the aims for this series of mathematics programs. Materials from the child's environment are frequently used for demonstration purposes. An inductive approach to many ideas is evident. In fact, there are occasions when problems remain unsolved or further experimentation is recommended for future mathematics periods.

The complete series consists of three segments. The first segment (Programs 1, 2, 3) centres around an introduction to Mathematics and ways to record and compare number ideas.

Segment Two (Programs 4, 5, 6, 7) discusses ideas of geometric figures and the measurement of these figures.

Segment Three (Programs 8, 9, 10, 11) presents ideas about the four operations (addition, subtraction, multiplication, and division) with whole numbers.

Several of the programs in this series involve student use of worksheets. For the convenience of the teachers, worksheet samples are included on a separate sheet of paper, where possible. This will facilitate duplication of such material in preparation for the telecast.

Mathematics Everywhere
Program 1

INTRODUCTION

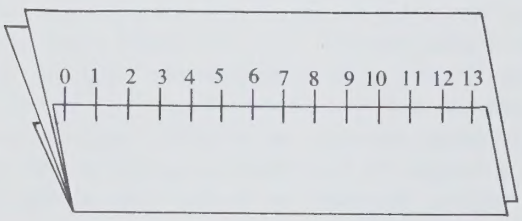
Each pupil will require a page of foolscap prepared according to the illustration below.

First Addend	Total	Second Addend

This is a line folded down the middle of the page.

The adding slide rule can be used as an alternate number line and to introduce an opportunity for re-examining addition and subtraction. Two pages of foolscap (the first folded lengthwise in quarters, the second folded lengthwise in half) will permit this arrangement. For pupils who have not had this experience, constructing it would be a worthwhile pre-telecast activity.

ADDING SLIDE RULE



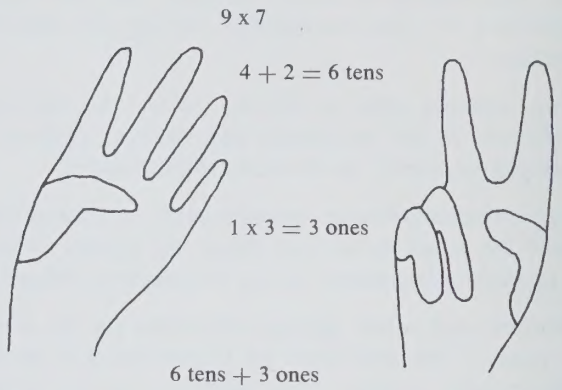
PROGRAM SUMMARY

The change in subject name from Arithmetic to Mathematics should have some significance for pupils of the junior division. To assist them, a variety of experiences using number, space, shape, and measurement have been included in the program. At times, consideration of more than one area is necessary. These ideas will receive additional attention in other programs in the series.

It is anticipated that the idea of "Mathematics Everywhere" will encourage the pupils to go beyond their texts in search of information and problems.

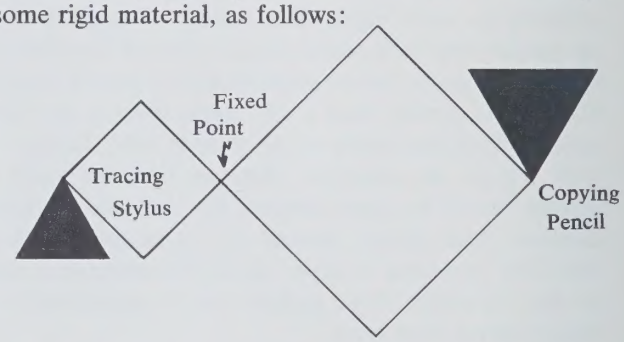
SUGGESTED FOLLOW-UP ACTIVITIES

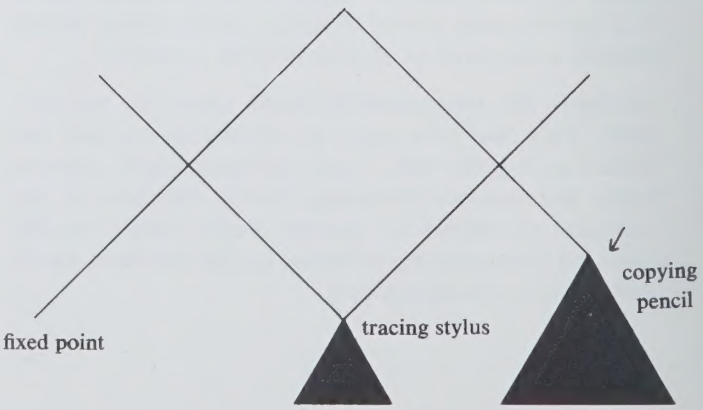
1 The student should be made aware of the general rule for hand multiplication; that is, the sum of the erect fingers represents the tens value of the solution and the product of the bent fingers represents the ones value.



2 A place in the classroom could be used profitably by pupils to store mathematical models, materials, and information. For example, as the ideas of measurement are developed, materials commensurate with the study could be collected for use in measuring. This collection area should not be a static display, but rather a place where work is done, reported, and refined by new challenges that apply measurement.

3 A classroom pantograph could be built from four strips of some rigid material, as follows:





Mathematics Everywhere
Program 2
Record and Compare

PREPARATION FOR TELECAST

Each pupil will require the following material:

1 Four sheets of blank paper

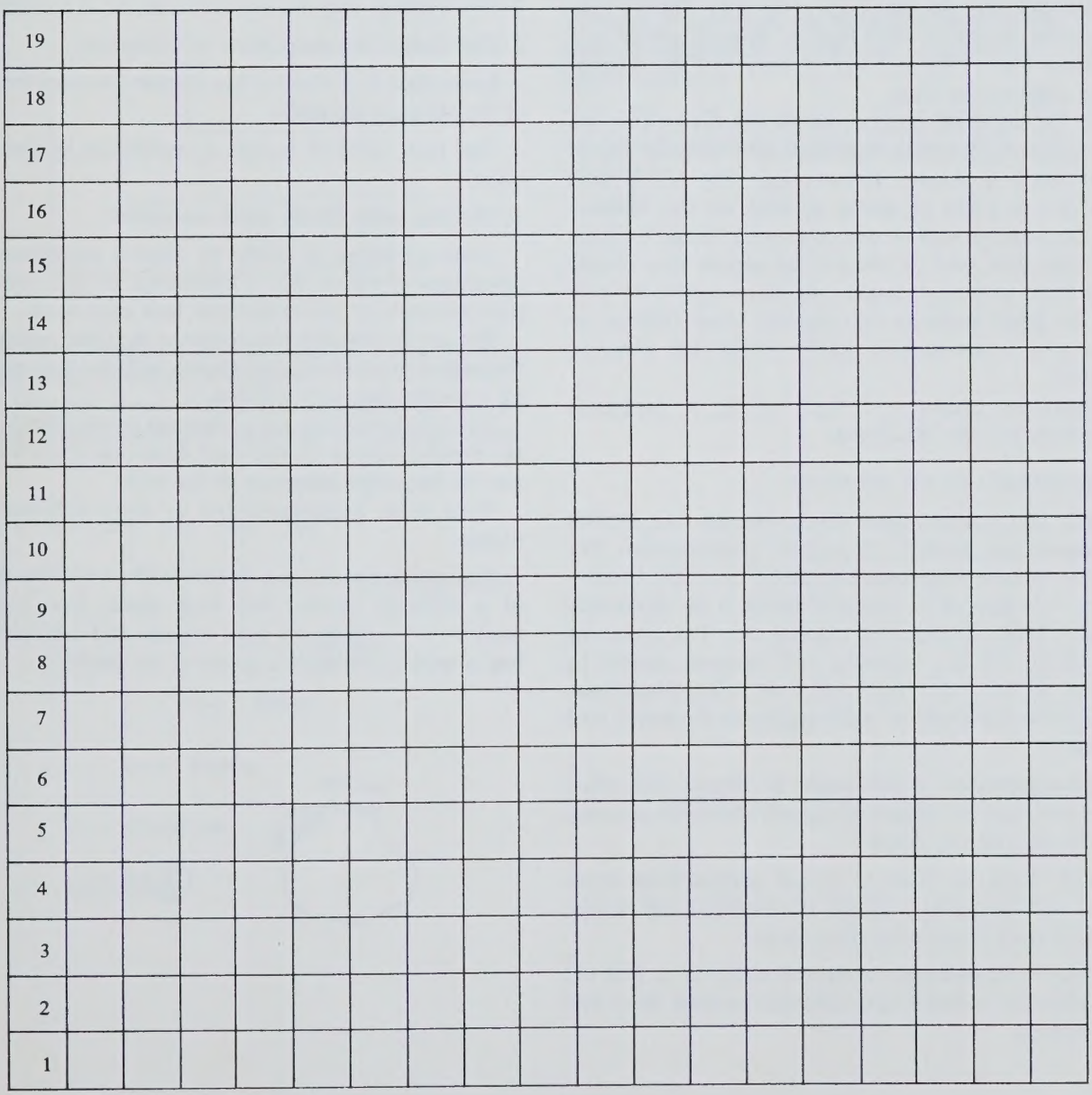
2 Four copies of Worksheet No. 1 (as illustrated below)

3 Pencil and ruler

It would be advisable for teachers to talk about graphs in advance of the program, particularly picture and bar-graphs.

WORKSHEET FOR GRAPHING EXERCISES

(4 sheets required for each pupil) Program 2



PROGRAM SUMMARY

The program provides an opportunity for the pupil to observe and participate because several ways to compare the size of two or more sets of objects, things or persons are presented. Methods of recording the relationships among the sets are also discussed.

The activities for comparing sets are discussed in the following sequence:

1 General observation of sets.

2 One-to-one matching of elements from one set with elements from a second set.

3 Use of a tally system to record the size of a group.

4 Counting to determine the cardinal number of sets.

5 Use of number of sentences to record relationships.

6 Pictorial representation of relationships (constructing and interpreting simple graphs).

The pupil audience is asked to count the number of boys and girls they see entering a soda shop. There is also an exercise in which the children actually graph (see Worksheet No. 1) the number of boys and the number of girls entering the shop.

Near the end of the program are two situations in which pupils construct graphs to represent four different sets of objects that they observe. For example, they will observe four different kinds of motor vehicles on the highway scene (eg. cars, trucks, buses, cars with house trailers). The pupils will need to observe the screen very closely during these graphing sessions. At one stage of the program the pupil audience will observe other children as they record, by means of a graph, certain data observed or known.

Interpreting graphs and then writing a paragraph about them are also discussed.

SUGGESTED FOLLOW-UP ACTIVITIES

1 Pupils and teacher could discuss topics that provide information for pictorial or graphic representation. For example, a) daily temperature recorded by graph; b) comparison of heights or weights of children in the classroom; c) pupils with different hair colours, etc. The lower the grade level, the less accuracy and neatness should be expected in the graph construction. It is important however that the construction of the graphs be the pupils own creation.

2 Pupil-constructed graphs could be shared with other pupils who, in turn, write a paragraph about the information recorded on the graph.

3 Pupils could be asked to collect graphs from newspapers and magazines. These, if simplified sufficiently, could provoke some lively discussions.

4 Pupils could undertake historical research to find out how primitive societies first recorded number ideas and relationships.

Mathematics Everywhere
Program 3
Our System of Numeration

PREPARATION FOR TELECAST

Each pupil will require the following material:

1 Two blank sheets of paper on which numbers can be recorded.

2 Pencil and straightedge.

Teachers could talk about situations in which a knowledge of large numbers is helpful.

PROGRAM SUMMARY

This program demonstrates visually how efficient our numeration system is. Experiences are presented which show the grouping or packaging that takes place when the number for a set of more than nine is recorded.

During the program, five key characteristics of our system of numeration are identified; namely,

1 *Ten* symbols *only* are needed to record a number.

2 *Zero* holds the empty place in a numeral.

3 Each place in a numeral has a value 10 times the value of the place on the right.

4 The face value of a digit is *multiplied* by the place value.

5 The real value of the digits are *added*.

Some reference is made to electric computers and calculators showing that a knowledge of our system of numeration helps us understand how they work.

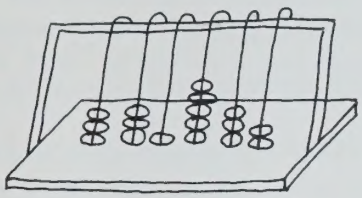
The pupils are asked to compare the time required by the puppet to perform a calculation with the time required by a simple electric calculator.

Two short exercises are performed by the pupils. They are asked to record six two-digit numerals in one exercise and six four-digit numerals in the other.

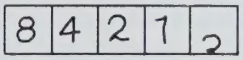
Place value is demonstrated by three different techniques:

1 Grouping or packaging in tens is illustrated by the use of a different symbol for each place. For example, markers are used in the ones column and a picture of a bag is used to illustrate a group of ten marbles.

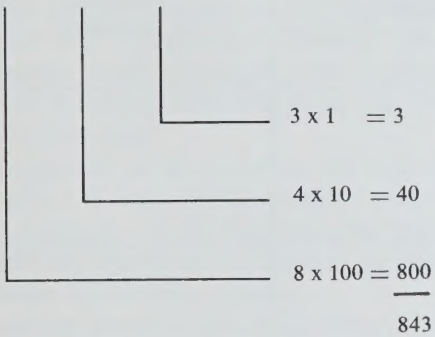
2 A bead frame or modified abacus is used to illustrate place value of larger numbers, each wire representing a value ten times the value of the place on its right.



3 A counting device similar to an *odometer* on a car (for recording miles travelled) is also used.

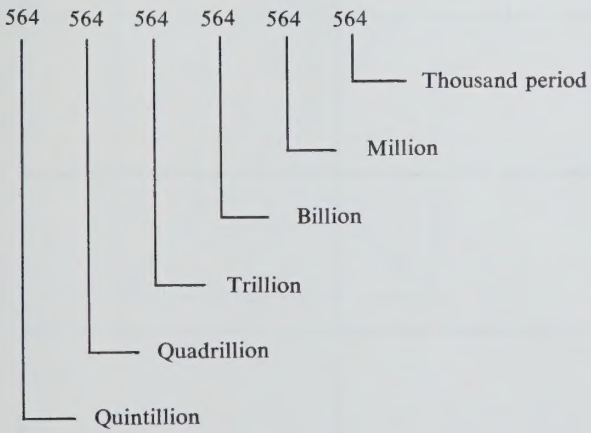


Near the end of the program the method of expanding a numeral is demonstrated.



This is done to illustrate how multiplication and addition are used when we record a number.

The program closes with a demonstration of how 3-digit number periods help us to record very large numbers.



SUGGESTED FOLLOW-UP ACTIVITIES

1 If characteristics of the decimal system are understood, the class could attempt to build another numeration system with a different base (the class would still utilize the key ideas of our own), for example:

Base Ten

a) Need ten symbols
b) Group in tens
c) Zero holds empty place
d) Each place to 10 times one on right

Base Five

a) Need five symbols
b) Group in fives
c) Zero holds empty place
d) Each place 10 times one on right

2 Pupils construct their own counting devices – a modified abacus or odometer. For example, an odometer can easily be constructed with a shoe box.

3 Pupils could study the historical development of systems of numeration through use of reference books and library facilities.

4 Pupils could investigate various ways people in the community use their knowledge of our system of numeration.

Mathematics Everywhere
Program 4
Shapes on Flat Surfaces

PREPARATION FOR TELECAST

Each pupil will require the following material:

1 Worksheet No. 1 (see illustration).

2 Three blank sheets of paper.

3 Pencil and ruler.

WORKSHEET NO. 1

Figure	Number of Faces	Number of Edges	Number of Vertices (corners)
A			
B			
C			
D			
E			
F			
G			

PROGRAM SUMMARY

The place of Geometry in Mathematics and the role of Geometry in scientific developments in the space age provide the introduction for this program.

Observation and appreciation of geometric shapes and forms in the world around us is encouraged. Ways to observe special characteristics are illustrated throughout the program.

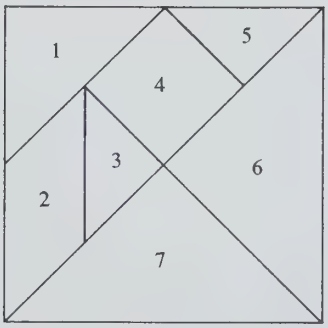
Observation of three-dimensional figures or geometric solids serves as an introduction for a study of "flat figures" or plane figures. Attention is focussed on the properties and boundary of a rectangular solid to identify the faces as being flat (plane region). We see that the edges are line segments, and that the corners (vertices) represent *points*. At this stage the pupils are involved in an exercise to identify faces, edges, and vertices of three solids.

The study of flat figures deals with a sequential development of the *point*, *line segment*, *open curve*, *closed curve*, and finally the *polygon*.

In the latter part of the program, the pupils are led to understand the idea of congruency. Through observation of line segments, angles, triangles, and quadrilaterals, congruency is developed with emphasis on "the *same shape* and the *same size*."

At the conclusion of the program, an experiment is performed with a triangle. If you join the midpoints of each side of a triangle, are the four triangles thus formed always congruent? Pupils are encouraged to experiment further in future mathematics classes.

A final activity involves the construction of line segments within a square and experimentation with the resulting polygons. Here is an illustration of the square depicting the seven polygons. (The square may be any size).



SUGGESTED FOLLOW-UP ACTIVITIES

1 The concluding part of the program (as mentioned above) suggests a follow-up activity.

2 Pupils could collect pictures that illustrate polygons of different shapes and different numbers of sides.

3 An art lesson (or lessons) on abstract design illustrating closed curves, with straight or curved edges, could be given. Evaluation of the pupils' work would no doubt provide material for discussion of many plane figures.

4 Pupils could cut out seven plane regions of any shape and arrange them to form a pattern so that any region is touched by only three other regions.

Mathematics Everywhere
Program 5
Solid Figures

PREPARATION FOR TELECAST

Each pupil will require the following material:

1 One copy of Worksheet No. 1

2 One copy of Worksheet No. 2

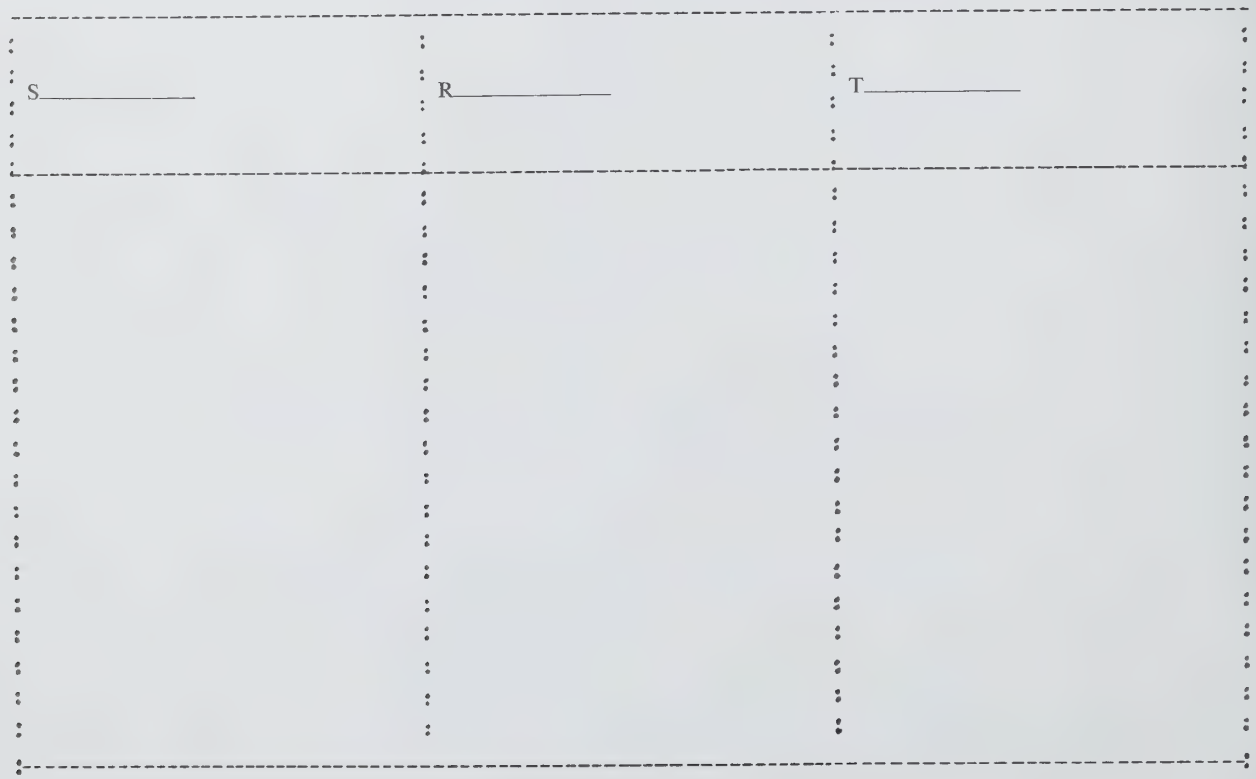
3 Two sheets of blank paper.

4 Pencil and ruler.

WORKSHEET NO. 1 (SAMPLE)

Solid	Shape of faces	Common Characteristics of faces
1		
2		
3		
4		
5		

WORKSHEET NO. 2 (SAMPLE)



It is recommended that the teacher provide cut-out patterns (see illustrated samples) for pupils to build models of solids as suggested in the follow-up activities. Some cardboard models or common geometric solids could be on display prior to the program.

Although many new terms for shapes are introduced, the important aspect of the program is the comparison of the characteristics of the various solids.

PROGRAM SUMMARY

A quick review of polygons and congruent figures provides the opening for this program. Also at the beginning are three short film clips depicting spinning, rolling and tilting actions. The children are asked to identify these actions. As the various geometric solids are discussed in the program, they will perform the actions illustrated in the film clips. The film for the action words is presented several times throughout the program.

The five regular solids are introduced first. Here the pupil audience is required to name the shape of the face and identify what is common about the faces in each solid. Worksheet No. 1 is used in this activity.

The five regular solids are:

1 Tetrahedron	4 faces	(congruent	triangles)	
2 Hexahedron (cube)	6	"	"	squares
3 Octahedron	8	"	"	triangles
4 Dodecahedron	12	"	"	pentagons
5 Icosahedron	20	"	"	triangles

The children then see a demonstration of how a flat pattern is sequentially folded to form a cube. This is followed by a story of what the Greeks thought about the five regular solids.

The cube then serves as a basis for the presentation of several prisms. In the same manner, the tetrahedron serves as the basis for presenting the characteristics of pyramids.

The solids that have something in common with the circle are then introduced; namely, the sphere, the cylinder, and the cone. The cylinder is likened unto the prisms; the cone is likened unto the pyramids.

The three action words, "spin, roll, and tilt" are then identified by the narrator. The program ends with the pupil audience using Worksheet No. 2. Each time a solid is shown on the screen and named, the children are asked to write the name of the solid in the column according to its performance of spinning, rolling, and tilting.

SUGGESTED FOLLOW-UP ACTIVITIES

1 Pupils could construct models by folding from cardboard patterns.

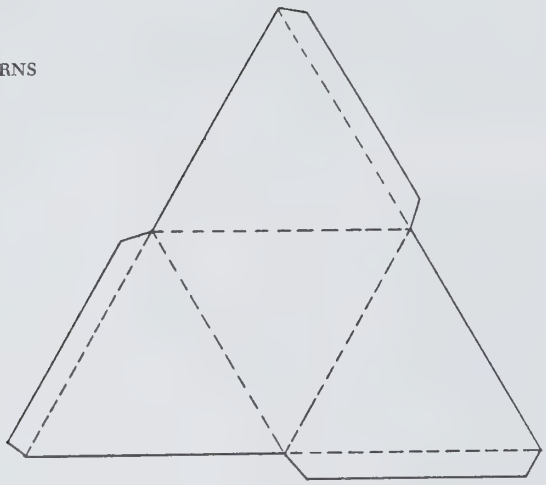
2 Pupils could create their own solids by folding cardboard without a pattern. The result could be many interesting, irregular solids, which could be hung in the classroom (mobiles).

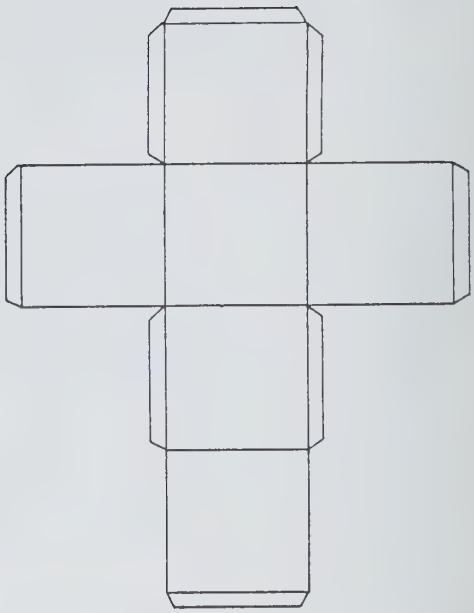
3 Pupils could create skeletons of solids through use of sticks, toothpicks, plasticine, and miniature marshmallows.

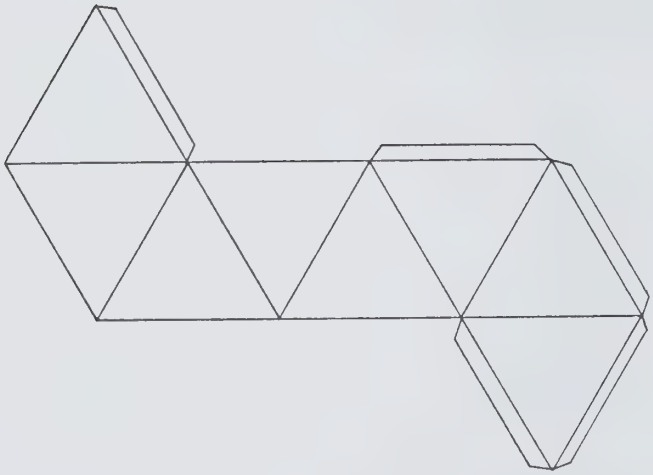
4 They could collect pictures that illustrate solids discussed in the program.

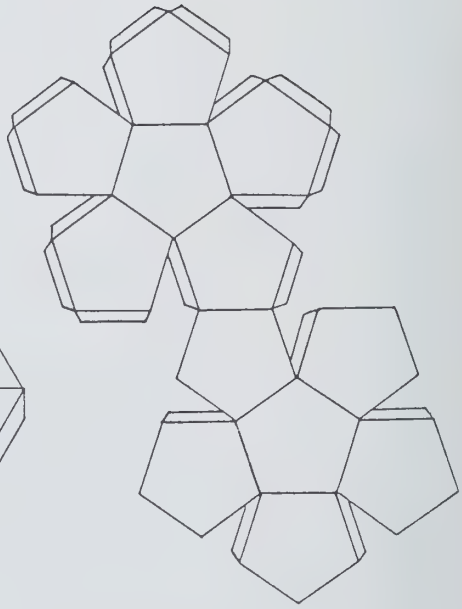
5 Meccano sets could be used to form skeletons of various solids.

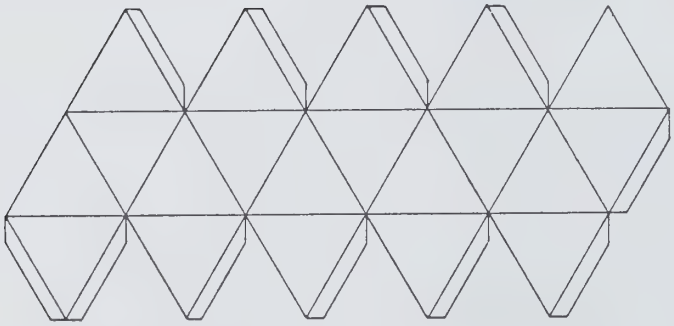
CUT-OUT PATTERNS











Mathematics Everywhere
Program 6
Introduction to Measurement

PREPARATION FOR TELECAST

Each pupil will require the following material:

1 One copy of Worksheet No. 1 (see sample illustrated).

2 One copy of Worksheet No. 2 (see sample illustrated).

3 Pencil and straightedge.

PROGRAM SUMMARY

There are numerous measurement situations illustrated in this program. In each instance emphasis is placed on the four stages of performing a measurement. They are:

1 Object to be measured.

2 Choice of a unit.

3 Actual measurement.

4 Recording the measurement.

Before measurement of geometric figures is discussed, considerable reference is made to measurement of such things as time, weight and liquids. Pupils will observe a child using a non-standard unit to measure the capacity of a jar. This is followed by a similar activity performed by Double M.

Three aspects of geometric measurement follow involving the measurement of the length of a segment, the *area* of a region, and the *volume* or *capacity* of a solid.

At no time in the program are standard units of measure used. All are improvised units, using objects familiar to the children from the real world.

The unit of length is a thin stick of wood; the unit for area is a square piece of plywood; the unit for volume is a block of wood in the form of a cube. No mathematical calculations of geometric measurement are used.

The significant purpose of the program is a) to identify how the three kinds of geometric figures are measured and b) to have the pupils realize that the unit of measure must be the same kind of figure as the figure to be measured.

Midway through the program two pupil exercises are initiated involving the use of Worksheets No. 1 and No. 2. In the first exercise the pupils see six different objects and for each they must decide whether a stick, a flat region or a wooden block would be used to measure it. For example, they see a picture of a freezer and are asked "how much space is inside?" Because this is a measurement of volume, the pupils write "freezer" in the column entitled "Cube or Block of Wood".

In the second exercise the pupils see ten different objects and are asked to imagine each as a unit of measurement. They must decide whether each is a unit for measuring length, area or volume. The name of the object is then written in the appropriate column on Worksheet No. 2.

The program ends with a review of the stages of measurement followed by three problem activities.

Problem One involves a boy travelling up and down on an elevator of a twelve-storey building.

Problem Two suggests that the pupil calculate how much money one would have if dimes (10¢) were placed side by side around the outer edge of the teacher's desk.

Problem Three, (really an activity), suggests that pupils find the length of numerous objects about the classroom, using an improvised unit of length, called the "Thumbdex" — the distance between the end of your thumb and index finger when both are outstretched.

SUGGESTED FOLLOW-UP ACTIVITIES

1 Pupils could be placed in groups to measure a series of four or five articles. The measuring could be length, area, volume or all three. Each group could use different improvised unit of measure. If each group were to make a graph of their findings, they would no doubt find it interesting to see a common form for the graph, even though the measures will be different.

2 Pupils could do a research project involving investigation of the history of our units of measure.

3 Considerable measurement of objects inside and outside the classroom could be directed by the teacher.

WORKSHEET NO. 1

Object	Wooden Stick	Flat Wooden Square	Cube or Block of Wood
1			
2			
3			
4			
5			
6			

WORKSHEET NO. 2

Object			
	1	2	3
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Mathematics Everywhere
Program 7
Length and Area

PREPARATION FOR TELECAST

Each pupil will require the following material:

1 One copy of Worksheet No. 1.

2 Two blank sheets of paper.

3 Pencil and ruler.

The teacher might have cut-out cardboard regions or tiles of varying shapes around the classroom.

PROGRAM SUMMARY

The program begins with a review of the stages involved in obtaining a measurement, with specific reference to the "Thumbdex". Reasons why the thumbdex is not always satisfactory as a unit of length point up the need for standard units of measurement.

The history of a variety of units of length is then presented. When units such as the hand, furlong, etc. are presented, no relationship with the inch, foot or mile is stated. Determining these relationships could inspire research activities in math. classes that follow the program.

Three different scales are used to determine the length of several objects. Here, pupils actually record the measurement as the three scales are associated with each object on the screen (see Worksheet No. 1).

Throughout the program, emphasis is placed on the fact that measurements are only approximate. No measurement is exact.

The latter part of the program deals with measuring the region of a plane or finding the area of a flat surface. The pupils see that, to measure a region, the unit of measure must also be a region.

Several flat shapes are then used as units to point up the fact that some shapes leave gaps when placed side by side to cover a larger surface. The children have an opportunity to record the area of a region using several units of measure. They also record area measurements for several flat shapes when a square grid (scale) is placed over each. It is difficult to determine the area of *irregular* plane regions.

A demonstration of covering an irregular patio with cement slabs of different sizes is intended to help the children realize that the smaller the unit of measure, the more accurate will be the measurement. The program ends with a demonstration of how things from the world around us could be used as units of measure for finding the area of a region.

It should be noted that, in this program, no measurements of length or area are performed with standard units. This was planned intentionally with the hope that the program activities with non-standard units would deepen the understanding of children's measurement experiences.

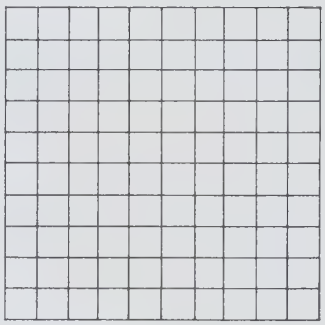
SUGGESTED FOLLOW-UP ACTIVITIES

1 Children could work in groups to find the area of surfaces such as classroom floor, desk tops, window opening, playground area, etc. Each group could use different improvised units of measure. Bar graphs could also be constructed for any given set of objects measured.

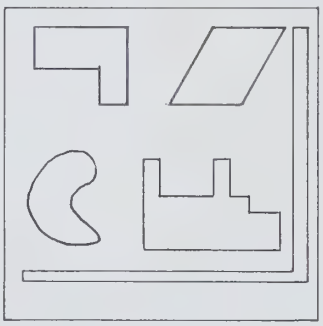
2 Children could cut out several congruent regions (using a variety of shapes) to see which regions might be used to cover a larger area without gaps.

3 Transparent grids or scales could be used by children to record the area of several regions, regular or irregular. The area would probably be found by counting the number of grid units needed to cover a particular region.

Scale

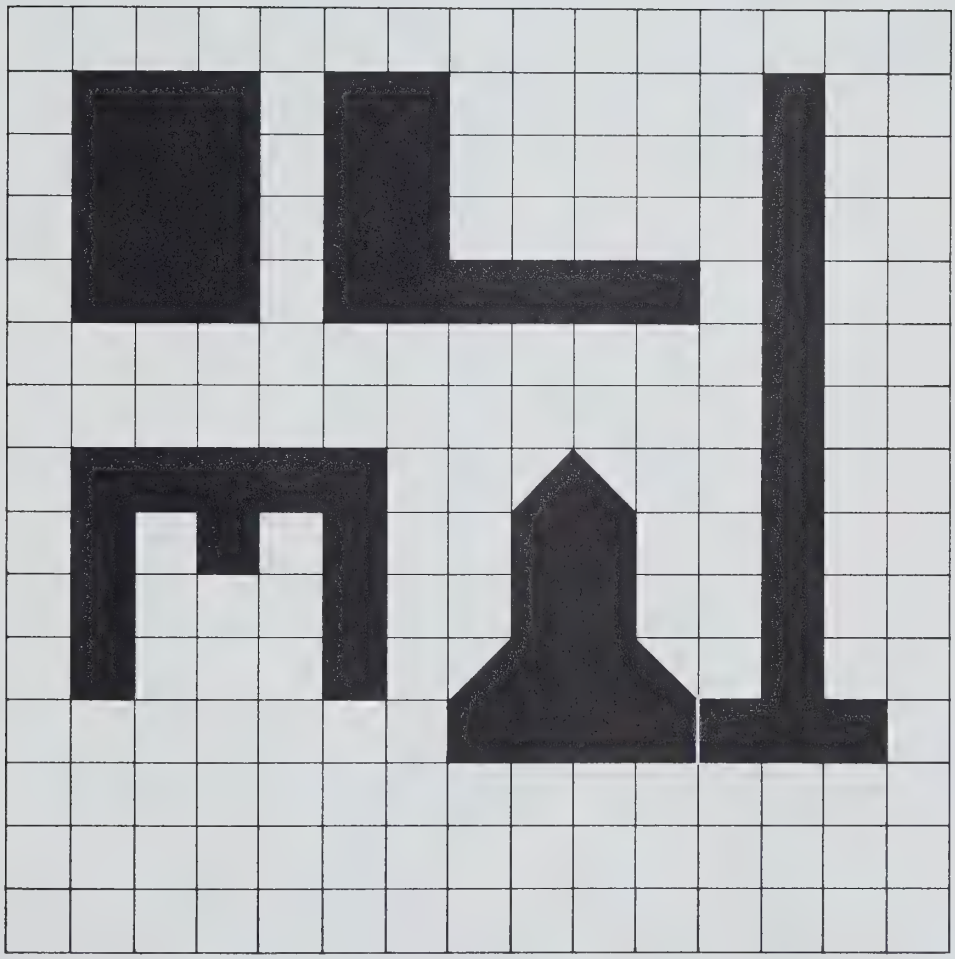


4 Squared paper could be distributed (graph paper with ¼″ squares or larger), and children asked to shade a definite area to form two or more regions of different shapes as illustrated.



EXAMPLE:

12 square units could be any of the shaded regions below:



WORKSHEET NO. 1

Item to be Measured	Scale "A"			Scale "B"			Scale "C"		
	Less than	More than	Closer to	Less than	More than	Closer to	More than	Less than	Closer to

Mathematics Everywhere
Program 8
Addition — Part 1

PREPARATION FOR TELECAST

There are no paper and pencil activities included in this telecast. Opportunities exist for pupils to make mental calculations and estimations. These should be self-correcting by virtue of the lesson development.

PROGRAM SUMMARY

This program is the first of two dealing with addition. It has been planned to review some of the basic ideas.

At the beginning, the idea of combining amounts is briefly considered and associated with the building of a numberline. Serial order in the number system is used to name the points on the numberline. The pattern of other ways to name the points is developed, including the identity element of addition.

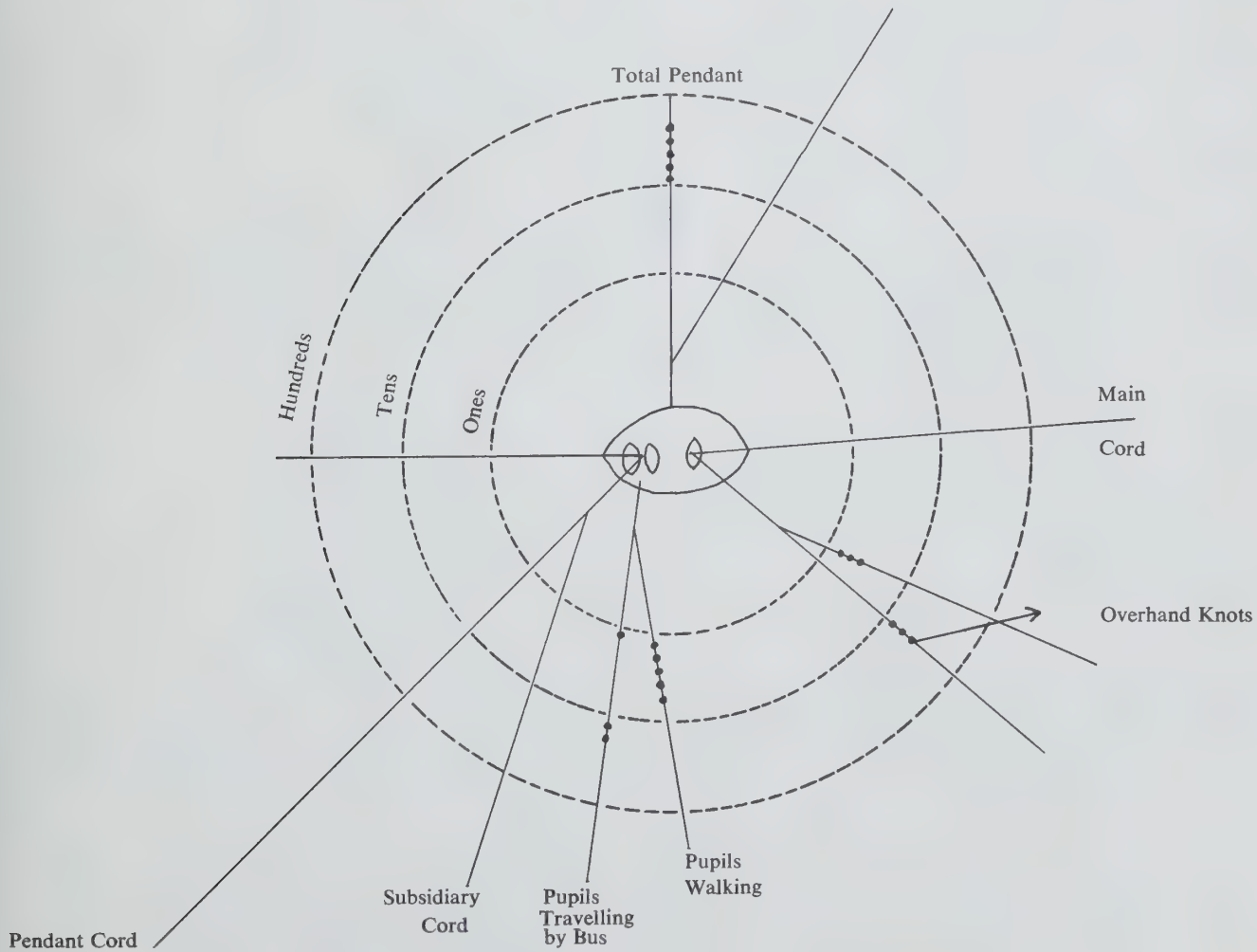
The patterns established with the numbers to ten are then considered, using larger numbers illustrated with squared paper and a spool abacus. As a conclusion the Japanese soroban and the Inca quipu are used as a recording apparatus for number.

SUGGESTED FOLLOW-UP ACTIVITIES

1 *The Inca Quipu (Kee-poo)*
After this program, students would likely enjoy further experience with the Inca quipu. It is a heavy main cord with thinner pendant cords attached. It appears that it was an apparatus used for recording number in a series of knots following a decimal pattern. Subsidiary cords attached to the pendant cord, above the ones placed, recorded information related to that on the main cord. A pendant cord attached on the opposite side of the main cord with several individual pendant cords held at the same spot totals the hundreds, tens, and ones. (See illustration below).

2 Experimentation with an abacus of some type to find how addition is performed could be planned.

3 Pupils could record information obtained from observation and find the new ideas that can be discovered from the observations by using addition.



Mathematics Everywhere
Program 9
Addition — Part 2

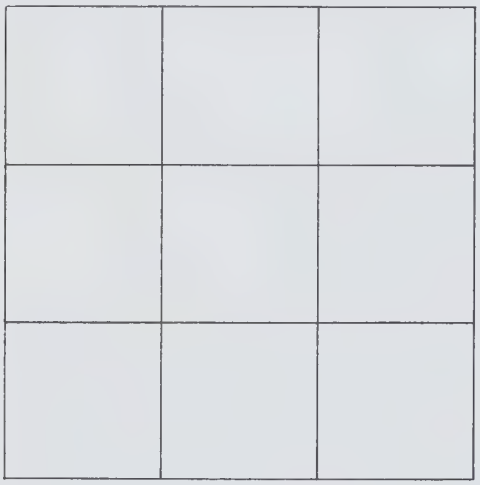
PREPARATION FOR TELECAST

Each pupil should prepare the following materials:

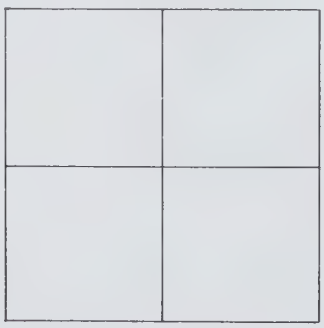
1 A grid showing the totals of pairs of numbers to (9.9).

	0	1	2	3	4	5	6	7	8	9
0	0	1	2	3	4	5	6	7	8	9
1	1	2	3	4	5	6	7	8	9	10
2	2	3	4	5	6	7	8	9	10	11
3	3	4	5	6	7	8	9	10	11	12
4	4	5	6	7	8	9	10	11	12	13
5	5	6	7	8	9	10	11	12	13	14
6	6	7	8	9	10	11	12	13	14	15
7	7	8	9	10	11	12	13	14	15	16
8	8	9	10	11	12	13	14	15	16	17
9	9	10	11	12	13	14	15	16	17	18

2 Two nine square grids.



3 A four square grid roughly centred on a piece of paper at least six inches square.



PROGRAM SUMMARY

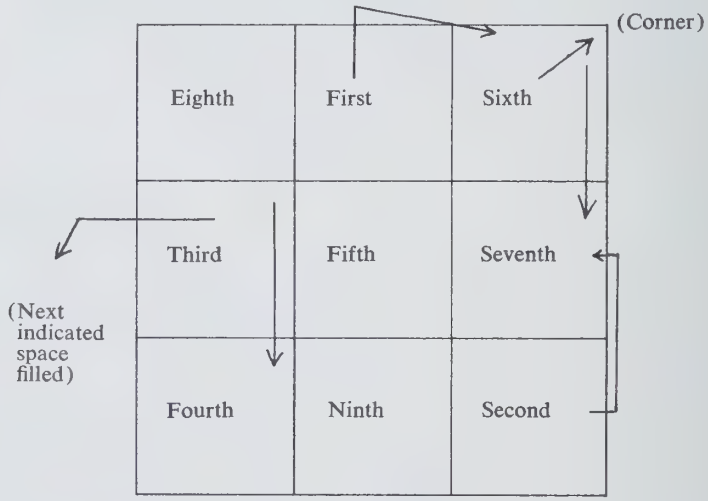
To continue the work initiated in the last program, the grid chart is used to record the ideas in an organized form. The chart is built up in the following phases: the identity element, serial order in the number system, the doubles, and the order property. Grouping is introduced to assist in extending the review to larger numbers. A balance square using the four square grid, a magic square using the two nine square grids, a chart for rapid addition included in the follow-up activities, and the ancient Greek ideas of triangular numbers are used to provide experience with addition.

SUGGESTED FOLLOW-UP ACTIVITIES

1 The pupils could discover patterns in the totals chart for pairs to (9.9).

2 They could build magic squares from series of numbers.

a) 9 square — order of making entries is indicated.



Follow a diagonal pattern moving to the opposite end of the column indicated when a space outside the square is reached unless situations such as the third and sixth entries are encountered.

b) "25" square follows the same pattern.

17	24	1	8	15
23	5	7	14	16
4	6	13	20	22
10	12	19	21	3
11	18	25	2	9

c) Other series of numbers may be chosen, or the square rotated to produce different magic squares.

3 The rapid addition chart could be explored further.

69	345	186	872	756
366	642	582	278	588
168	246	87	575	657
762	147	285	377	954
663	543	483	179	855
564	48	384	674	459

4 Triangular numbers could be used to find products. Each ordinal number can have a triangular number associated with it.

		And so on to —	
First	1	Fourteenth	105
Second	3 (1+2)	Fifteenth	120
Third	6 (1+2+3)	Sixteenth	136
Fourth	10 (1+2+3+4)	Seventeenth	153
Fifth	15 (1+2+3+4+5)	Eighteenth	171

14×4

Total the numbers to be multiplied..... 18
Write the eighteenth triangular number.....171
Subtract the fourteenth triangular number..... 66
Subtract the fourth triangular number..... 56

$14 \times 4 - 56$

5 Totals of two triangular numbers could be compared with a square number.

Square numbers	
1	— 1
1 + 3	— 4
1 + 3 + 5	— 9
1 + 3 + 5 + 7	— 16
1 + 3 + 5 + 7 + 9	— 25

6 Knowledge of odd and even number combinations through experimentation helps in making valid estimations.

Mathematics Everywhere
Program 10
Multiplication

PREPARATION FOR TELECAST

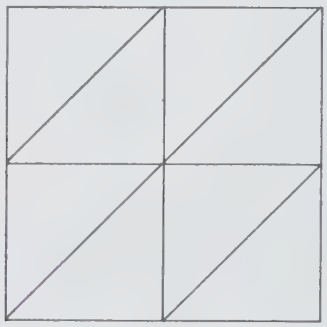
Each pupil will require the following material:

a) A grid chart of products of pairs of numbers to (9.9)

	0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9
2	0	2	4	6	8	10	12	14	16	18
3	0	3	6	9	12	15	18	21	24	27
4	0	4	8	12	16	20	24	28	32	36
5	0	5	10	15	20	25	30	35	40	45
6	0	6	12	18	24	30	36	42	48	54
7	0	7	14	21	28	35	42	49	56	63
8	0	8	16	24	32	40	48	56	64	72
9	0	9	18	27	36	45	54	63	72	81

b) A page of paper on which to make some calculations

c) A four square grid with diagonals. The chart should be approximately centred in a 6″ x 6″ space.



PROGRAM SUMMARY

Multiplication is considered as repeated addition. Reference is also made to pairing one set of objects with another set of objects. Various objects, blocks of squared paper, and grid charts are used to encourage the investigation essential to achieving facility with more abstract applications of the operation.

The ordering property, the grouping property, and the identity element of multiplication are included as areas of exploration. These should appear related to an idea-testing situation, not as isolated studies of properties of the number system.

For interesting opportunities to apply multiplication skill, the pupils are introduced to an Asian method of multiplication (doubling and adding), lattice multiplication, and a code based on multiplication.

SUGGESTED FOLLOW-UP ACTIVITIES

1 The pupils could build block-charts to illustrate the products indicated on lines of the chart made during the pre-telecast activity period.

2 Pupils could experiment by cutting blocks of squared paper representing the product of a pair of numbers to find other ways that the number can be stated.

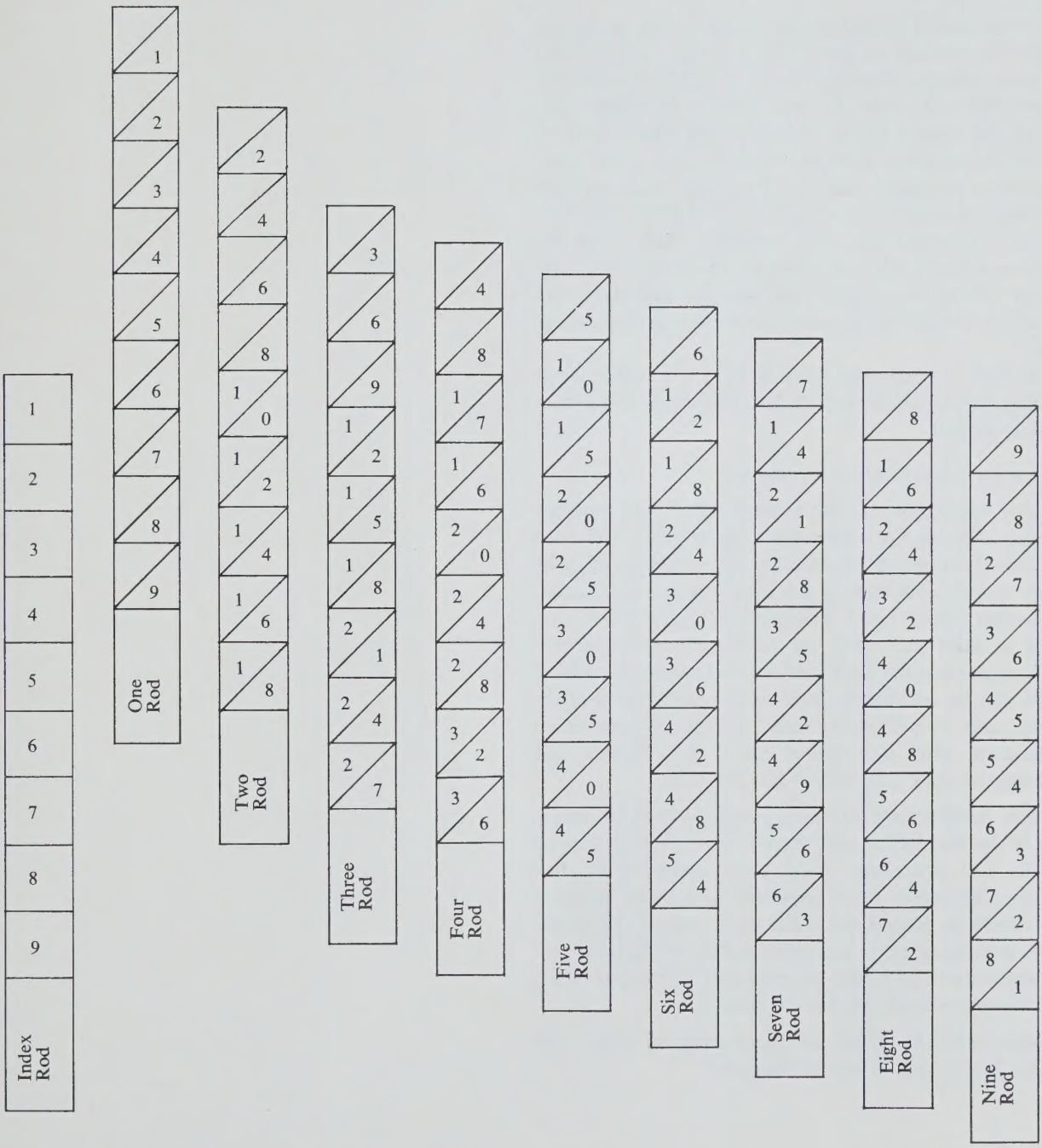
2×6

$(1 \times 6) + (1 \times 6)$

3 Pupils could build a set of Napier's Rods on pieces of 1 x 1 lumber or on strips of cardboard and use them to solve multiplication questions.

Pupils could select the rods to indicate the digits in the multiplicand. They could calculate the partial products by reading them opposite each digit of the multiplier as found on the index rod.

Note: The solution to the coded message in the program is MATHEMATICS spelled backwards.



Mathematics Everywhere
Program 11
Subtraction and Division

PREPARATION FOR TELECAST

Blackboard diagrams or charts of the following will assist the classes:

1 a clock face showing the numeral for each hour.

2 a circle with marks to indicate each quarter of the circumference.

PROGRAM SUMMARY

Subtraction and division are the topics for this program. By way of introduction, the 24-hour system of indicating time is developed as an opportunity to apply a knowledge of subtraction. Division is used when a four-place dial replaces the regular clock. Numerals are represented on this dial by repeated subtraction of the four units, each indicating a complete rotation of the dial hand, and the remainder shown by the position of the hand on the dial.

From this point the class considers what must be added, as a key number, to complete the turn of the hand to zero. These ideas based on modular arithmetic are applied in computer operation to verify certain entries made.

Activities to encourage estimation as a valuable assist to computation are included. So is multiplication as a method of proof.

SUGGESTED FOLLOW-UP ACTIVITIES

1 Pupils could estimate the number of a large quantity of things. The pupils could count the number contained in a certain weight of the objects. The numbers of units of this weight contained in the total amount is obtained by division. These units multiplied by the number contained in each unit give the estimated total quantity. Where scales are not available, related arbitrary units of weight can be constructed and used with a home-made balance arm. A coil spring with equal units graphed on an attached chart is a useful device for children just beginning to work with the idea of division.

2 Pupils could record information gained from investigations in the real world and discover how division can be used to find new ideas about these observations. For example, the pupils might consider how many pairs of boots could be placed along the back wall of the cloakroom. Assuming they had investigated to find the approximate width of a pair of boots and the length of the wall, division would provide the answer.

3 Pupils could be given an opportunity to work with division facts using "Clock-Arithmetic".